

Related Application

This reissue application is a continuation of reissue application no. 09/094,575 filed on June 12, 1998.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a copy prevention method and apparatus of a digital [magnetic] recording/reproducing system, and more particularly to a copy prevention method and apparatus of a digital [magnetic] recording/reproducing system, wherein a marker [involving copy prevention function information and executing the function is coded and inserted to perform the copy prevention function and realize the copy prevention function of various patterns desired by a program supplier] includes control data for descrambling digital data.

2. Description of the Prior Art

One example of a conventional copy prevention method is described in U.S. Pat. No. 4,819,098, in which a signal inducing an interference to an automatic gain controller (AGC) circuit within a VCR is inserted to a video waveform to be recorded on a tape. When the tape is reproduced to display the signal on a television, the interference signal does not affect the AGC circuit of the television, [to allow] allowing for a normal display.

However, when the reproduced signal is recorded by another VCR, i.e., when it is duplicated, the interference signal brings about [the] interference in the AGC circuit of the recording VCR causing [to record in] an inaccurate signal level to be recorded. Accordingly, the nodal display cannot be attained when reproducing a duplicated tape.

As another example, U.S. Pat. No. 4,571,642 utilizes a control track employed during performing the reproduction for synchronizing a servo circuit within a VCR, [thereby] for embodying the copy prevention function. The basic concept of this patent is for altering a video signal to force the control track to be inaccurately recorded when the video signal is duplicated onto another tape.

Still another example is disclosed in U.S. Pat. No. 4,577,216, in which a phase noise or the like is inserted [to] in a chroma burst portion of a video signal to thereby embody the copy prevention function.

The above-mentioned methods [are for using] use a difference between the [of] sensitivity [between] of circuits [of] in a television and [of] a VCR. [Thus, the copy prepared to prevent the copy thereof as above may not exert the copy prevention function in a certain VCR, but may not execute a normal display on a certain television.]

The above copy prevention methods are of an analog system, which are available for preventing the copy of an NTSC-class video signal to an analog VCR. However, in case of a high-definition image of the analog television (ATV), the copy is performed by means of a digital VCR rather than an analog VCR, so that it is difficult to employ the copy prevention method of the analog system.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a copy prevention method and apparatus of a digital [magnetic] recording/reproducing system [applicable to a digital VCR and incorporated with various copy prevention functions to enable the selection of a copy prevention function desired by a program supplier.

Also, a copy prevention apparatus of a digital magnetic recording/reproducing system includes a marker detecting and inserting part for detecting a marker from input bit strips, and inserting the updated marker to the bit strips to output the result. A marker analyzing and processing part decrypts and analyzes the encrypted marker from the marker detecting and inserting part by means of an encoded key, outputs a control word for descrambling the bit strips, and updates and encrypting the decrypted marker by means of the encoded key to output the result. In addition, a buffer part buffers the control word and updated and encrypted marker from the marker analyzing and processing section, and inserts the updated and encrypted marker in the marker detecting and inserting part, and a descrambler descrambles the bit strips provided via the marker detecting and inserting part by means of the control word from the buffer part.]

These and other objects are further achieved by providing a method of processing copy protected digital data, comprising receiving digital data said digital data including copy prevention information; determining from said copy prevention information whether copying is permitted; updating said copy prevention information if said determining step determines that a copy is permitted; inserting said updated copy prevention information in place of said copy prevention information only in said digital data for recording; and recording output from said inserting step.

In an alternative embodiment, the scrambled digital data and the marker are recorded.

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data, comprising a receiving unit receiving digital data, said digital data including copy prevention information; an analyzing unit determining from said copy prevention information whether copying is permitted, and updating said copy prevention information if a copy is permitted; an inserting unit inserting said updated copy prevention information in place of said copy prevention information only in said digital data for recording; and a recording unit recording output from said inserting unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and other advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a flow chart illustrating an audio and video signal transmitting process in a copy prevention method according to the present invention;

FIG. 2 is a flow chart illustrating an audio and video signal receiving and recording process in the copy prevention method according to the present invention;

FIG. 3 is a view showing a structure of transport bit strips according to the present invention;

FIG. 4 is a block diagram showing a schematic construction of a copy prevention apparatus according to the present invention;

FIG. 5 is a block diagram showing a detailed construction of FIG. 4; and

FIGS. 6A to 6F are signal waveforms of respective parts shown in FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A copy prevention method and apparatus of a digital [magnetic] recording/reproducing system according to the present invention [emphasizes a fact that a DVCR can record all diverse signals on a video tape, so that a variety of input signals are largely classified into two, and different] use a copy prevention [methods are performed for each signal] method based on the type of input signal.

First, signals transmitted from a terrestrial broadcasting system, a satellite broadcasting system and a pay television broadcasting system are classified as [a] broadcasting [signal] signals, and the following three copy prevention functions are applicable when recording [the] a broadcasting signal.

The three [Three] copy prevention functions are a no recording permitted [onto a video tape], a free record/copy [onto the tape], and a single generational recording [onto the tape with no copy of the recorded tape].

Here, the third copy prevention function [of the single generational recording onto the video tape with no duplication of the recorded tape] is for enabling the signal from a television receiver to be recorded [record on the tape] once but [inhibiting] the re-recording of the signal by means of, for example, [another] a DVCR is prohibited while the firstly-recorded [tape] signal can be reproduced to watch through a monitor.

A second classification is for, for example, a rental tape to be identified by a pretaped signal. Here, the copy prevention function of the pretaped signal is similar to the above no recording [onto the tape] and the free record/copy copy protection function [onto the tape], [which] and has the following three copy protection functions.

The three functions are no copy onto another tape, free copy to another tape and a single generational copy to another tape.

The single generational copy function [to the other tape is of the copy prevention function for allowing a] allows duplication from the original [rental tape], but inhibits [inhibiting] another copy from the [duplication] duplicate[, which is utilized in a digital audio tape (DAT)].

The present invention is advantageous in that a program supplier selects the above functions when providing a program. For this purpose, the program supplier inserts desired copy prevention function information, i.e., a marker, into a predetermined field within the program.

The marker inserted [to transport data] by the program supplier prior to being transmitted is encoded, and, in order to impede an illegal copy, an encoding key for interpreting the marker is transferred via a separate transmission line such as telephone line by a prescribed period interval, e.g., once a month, to be stored within a copy prevention apparatus.

In a system having an ATV decoder incorporated in a body with, for example, the DVCR [in a body], a copy prevention apparatus for embodying the copy prevention functions executes a digital copy prevention function during an interface process between the ATV decoder and the DVCR [, and] The copy prevention apparatus decodes and determines the marker of a received program by means of a received [encoded] encoding key to perform another function in accordance with respective copy prevention functions.

The copy prevention method of the digital [magnetic] recording/reproducing system according to the present invention is performed through an audio and video signal transmitting process as shown in FIG. 1, and an audio and video signal receiving and recording process as shown in FIG. 2.

The audio and video signal transmitting process is for encrypting the marker formed by a control word for scrambling audio and video bit strips and copy prevention (hereinafter simply referred to as "CP") information for preventing an illegal duplication by means of an encoded key to multiplex and transmit the audio and video bit strips scrambled by the control word. Here, the marker is already formed by a program producer to be multiplexed and transmitted together with the audio and video bit strips.

In more detail, as shown in FIG. 1, the audio and video signal transmitting process is carried out in the sequence of an audio/video bitstrip encoding step 1 for encoding the audio and video bit strips, a control word generating step 2 for generating the control word for scrambling, and a scrambling step 6 for scrambling the encoded audio and video bit strips by means of the generated control word. Successively, a CP information generating step 3 generates the CP information for preventing the illegal copy, and marker producing and encrypting steps 4 and 5 respectively generate [generates] the marker by using the generated control word and CP information and [encrypts] encrypt the resulting marker by means of [the encoded] an encoding key. Finally, a multiplexing and transmitting step 7 multiplexes the scrambled audio and video bit strips and encrypted marker to transmit the result.

The audio and video signal receiving and recording process is performed in such a manner that the marker is detected from the transmitted bit strips and is decrypted by means of the [encoded] encoding key and analyzed. Thus, it is determined whether the copy is permitted or not, the detected marker is updated accordingly [to update the detected marker to be recorded on a video tape], and the control word is

When the marker is decrypted by means of the [encoded] encoding key, the decrypted marker is divided into a CP

That is, the decrypted marker is formed of 8 bytes consisting of the CP information area of one byte, the reserved area of three bytes and control word area of four bytes.

Next, the marker analyzing step 13 of the audio and video receiving and recording process will be described in detail.

In other words, the CP information for preventing [the] an illegal copy is detected from the detected marker, and the allowable generation of the allowable generational field for limiting the copy number of the program is compared with the current generation of the current generational field representing the current generation of the duplicated program within the detected CP information to determine whether the copy is permitted or not, so that the program is recorded in case of permitting the copy. Otherwise, [otherwise the] reproduction cannot be executed in case of inhibiting the copy, even though the recording is attained.

Here, the step of limiting the copy number is carried out by comparing the allowable generation of the allowable generational field with the current generation of the current generational field to determine whether the allowable generation is the current generation, inhibiting the copy when it is determined that the allowable generation is below the current generation, and permitting the copy when it is determined that the allowable generation is not below the current generation [to proceed to the marker insertion step].

When the allowable generation is below the current generation after comparing the allowable generation of the allowable generational field preset by the program producer with the current generation of the current generational field representing the current copy number, the copy number exceeds the copy number preset by the program producer. Thus, copying cannot be [the copy cannot be further] permitted.

Therefore, by destructing the control word, the reproduction and display cannot be achieved even though the

audio and video bit strips are recorded; [to] thereby [have] having the same effect [of] as impeding the recording of them.

At this time, since the control word is periodically changed of an [in the] interval of 0.6 second, the reproduction is impeded by destructing the succeeding control word even after accomplishing the recording.

Also, a control track within the video tape may be destructed to inhibit the copy when the recording medium is a video tape.

On the other hand, the marker is positioned on the private data field within the bit strips whenever the control word is changed.

Here, since the control word is periodically changed, the marker including the control word is received whenever the control word is changed [to be supplied].

Meantime, the marker inserting step is performed by updating the marker when the copy is permitted after analyzing the marker 16, encrypting the updated marker by means of the encoded key 17, and replacing the encrypted marker with the [following] marker to be inserted 18.

In other words, if the copy is permitted after analyzing the marker, the current generation of the current generational field is augmented by one to update the marker 16. That is, the CP information including the updated current generational field obtained by augmenting the current generation by one is summed with the control word to be the updated marker.

The updated marker is encrypted by means of the encoding key and is inserted to replace [encoded key to be replaced with] the succeeding marker [and inserted] 17. More specifically, as the marker is supplied whenever the control word is changed, it is inserted whenever the control word is changed.

In other [word] words, as shown in FIG. 3, the detection of the encrypted marker and the replacement of the updated marker should be accomplished altogether on time basis.

Meanwhile, the [encoded] encoding key for encrypting and decrypting the marker is transmitted via a separate transmission line in a predetermined time interval and is stored to be utilized, thereby perfectly preventing the illegal copy.

That is, the marker encrypted by the [encoded] encoding key is transmitted and recorded together with the bit strips. Here, the control word for descrambling the scrambled audio and video bit strips is included in the marker, so that the marker should be primarily decrypted to obtain the control word. However, since the [encoded] encoding key for decrypting the marker is periodically changed, it is impossible to decrypt the marker without the [encoded] encoding key. Accordingly, it is further difficult to illegally obtain the control word.

As shown in FIG. 4, the copy prevention apparatus of the digital magnetic recording/reproducing system according to the present invention includes a marker detecting/inserting section 21, a descrambler 24, a marker analyzing/processing section 22 and a buffer section 23.

Marker detecting/inserting section 21 detects the marker from the received bit strips, and inserts [to output] the updated marker, i.e., the updated and encrypted marker, from buffer section 23 to the bit strips.

Marker analyzing/processing section 22 utilizes the [encoded key] encoding keys to decrypt and analyze the encrypted marker from marker detecting/inserting section 21, thereby providing the control word CW for descrambling the bit strips. Then, the decrypted marker is updated and encrypted by the [encoded] encoding key [to be] for output.

Buffer section 23 buffers control word CW and the updated and encrypted marker IEM from marker

analyzing/processing section 22, so that the updated and encrypted marker IEM is supplied to be inserted in marker detecting/inserting section 21.

Descrambler 24 descrambles the bit strips output via marker detecting/inserting section 21 by means of the control word CW from buffer section 23 to supply the result to the monitor to be displayed or to, for example, a DVCR to record the bit strips [inserted] with the marker.

Here, the [encoded] encoding key is transmitted via the separate transmission line [in] at a predetermined time interval and is stored as the copy prevention method of the digital magnetic recording/reproducing system according to the present invention to double a copyright protection effect.

Referring to FIG. 3, the structure of the transport bit strips and marker will be described prior to describing the operation of the copy prevention apparatus of the digital magnetic recording/reproducing system constructed as above.

In the copy prevention apparatus of the digital magnetic recording/reproducing system, the marker is placed on the transport-private-data field within the bit strips, and the CP information area recorded with the CP information for preventing the illegal copy and the control word area recorded with the control word CW for descrambling are included thereto as shown in FIG. 3, like the copy prevention method.

Here, the CP information is formatted by including the generational copy control field for restricting the number of permitted copies of the program, which is formed of the allowable generational field for limiting the copy number of the program and the current generational field representing the current generation of the duplicated program.

The marker is formed of 8 bytes consisting of the CP information area of one byte and control word area of four bytes.

Hereinbelow, an operation of the copy prevention apparatus of the digital [magnetic] recording/reproducing system according to the present invention will be briefly described with reference to FIG. 4.

First, a process of displaying the input bit strips on the monitor will be described.

The input bit strips are supplied to marker analyzing/processing section 22 under the state that the marker is detected and encrypted in marker detecting/inserting section 21.

Encrypted marker EM is decrypted by means of the [encoded] encoding key to be analyzed in marker analyzing/processing section 22. At this time, the control word is detected from the analyzed marker [to be buffered] via buffer section 23 for descrambling the bit strips and is supplied to descrambler 24.

The bit strips, after [detecting] the detection of the marker in marker detecting/inserting section 21, are descrambled in descrambler 24 in accordance with the control word from buffer section 23, and provided to the monitor [to be displayed] for display.

Next, a process of recording the input bit strips via, for example, the DVCR will be described.

The process of detecting and analyzing the marker from the input bit strips is executed in the same manner.

That is, the input bit strips [is] are supplied to marker analyzing/processing section 22 under the state that the marker is detected and [encrypted] decrypted in marker detecting/inserting section 21.

Encrypted marker EM is decrypted by means of the [encoded] encoding key in marker analyzing/processing section 22 to detect the control word. At this time, the recording can be performed or not in accordance with the

Buffer section 23 includes a marker buffer 36 for temporally storing the updated and encrypted marker from marker analyzing/processing section 22 to supply it to marker detecting/inserting section 21, and a control word buffer 37 for temporally storing the control word from marker

analyzing/processing section 22 to supply it to descrambler 24.

An operation of the copy prevention apparatus of the digital magnetic recording system according to the present invention constructed as above will be described with reference to FIG. 6) FIGS. 6A-6G.

FIG. 6A is a timing chart of the transmitted bit strips, FIG. 6B [is of] illustrates the marker detection flag m-det-flag, FIG. 6C [is of] illustrates the control word CW(i) from marker analyzer 34, FIG. 6D illustrates [is of] the updated and encrypted marker IEM(i) from marker updating/encoding unit 35, FIG. 6F [is of] illustrates the updated and encrypted marker IEM(i) from marker buffer 36, and FIG. 6G [is of] illustrates the control word CW(i) from control word buffer 37.

Encrypted marker EM(i) is included in the transmitted bit strips.

The transmitted bit strips including encrypted marker EM(i) [is] are formed as shown in FIG. 6A, which is supplied to marker detector 31 to detect encrypted marker EM(i) to be supplied to marker decoder 33. Also, marker detector 31 generates marker detection flag signal m-det-flag for informing of the position of [the encrypted marker at] the encrypted marker EM(i) [portion] as shown in FIG. 6B, so that the generated signal is supplied to marker inserter 32 together with the bit strips including encrypted marker EM(i). Also, marker detection flag m-det-flag is supplied to descrambler 24 to be utilized as the reference signal for initializing descrambler 24 by control word CW(i-1) from control word buffer 37.

Encrypted marker EM(i) is decrypted by the encoding key in marker decoder 33 [to be] and is supplied as decrypted marker M(i).

Decrypted marker M(i) is analyzed in marker analyzer 34 to determine whether the copy is permitted or not. In other words, marker analyzer 34 compares the CP information within decrypted marker M(i), i.e., the allowable generational field with the current generational field, and determines to permit the copy when the allowable generational field is not below the current generational field.

When the copy is permitted [as above], marker analyzer 34 slightly delays control word CW(i), which is a part of decrypted marker M(i), to be supplied to control word buffer 37, as shown in FIG. 6C. At this time, marker analyzer 34 [provide] provides the control signal to marker updating/encoding unit 35 to control the updating of the marker.

That is, marker decoder 33 [form] forms decrypted marker M(i) from encrypted marker EM(i) after a delay [delaying a] time required for the decode, and the marker analyzer 34 generates control word CW(i) from decrypted marker M(i) [in marker analyzer 34].

At this time, control word CW(i) is transmitted to control word buffer 37 to be stored until it is utilized in descrambler 24.

Decrypted marker M(i) from marker decoder 33 is updated in accordance with the control signal from marker analyzer 34 in marker updating/encoding unit 35.

That is, the updated data is the data recorded on the current generational field within the marker, which is obtained by adding one to the previously recorded current generation.

The marker updated as described above is encrypted, i.e., encoded, in accordance with the [encoded] encoding key to be supplied to marker buffer 36 as shown in FIG. 6D, slightly delayed with respect to control word CW(i) from marker analyzer 34 as shown in FIG. 6C. In more detail, the encrypted marker M(i) from marker decoder 33 is supplied to marker

updating/encoding unit 35 to be generated as marker IEM(i), which is updated and encrypted after a delay [delaying the] time required for the encoding, and marker IEM(i) is [to be] supplied to marker buffer 36.

Here, the point of generating updated and encrypted marker IEM(i) and control word CW(i) from marker updating/encoding unit 35 and marker analyzer 34 does not coincide with a point of utilizing updated and encrypted marker IEM(i) and control word CW(i) in marker inserter 32 and descrambler 24, i.e., the points of performing the replaceable insertion and initialization of descrambler 24 do not coincide with each other. Thus, updated and encrypted marker IEM(i) and control word CW(i) from marker updating/encoding unit 35 and marker analyzer 34 are temporally stored in marker buffer 36 and control word buffer 37 for that time.

As shown in FIG. 6E, updated and encrypted marker IEM(i) temporally stored in marker buffer 36 and synchronized to be output is inserted by marker inserter 32 into [to] the bit strips from marker detector 31.

In more detail, marker inserter 32 receives the bit strips having encrypted marker EM(i) and marker detection flag signal m-det-flag from marker detector 31, and receives updated and encrypted marker IEM(i) which will be replaceably inserted into [to] the position of encrypted marker EM(i) from marker buffer 36, so that updated and encrypted marker IEM(i) is replaceably inserted to the position of marker detection flag signal m-det-flag in the transmitted bit strips including encrypted marker-EM(i) as shown in FIG. 6E.

In other words, marker inserter 32 inserts updated and encrypted marker IEM(i) from marker buffer 37 replacing encrypted marker EM(i+1) at the position of producing marker detection flag signal m-det-flag.

Here, the replaceably inserted marker IEM(i) is formed from the immediately detected preceding encrypted marker. Accordingly, as shown in FIG. 6E, the marker IEM(i) is stored in marker buffer 37 for a certain period [to be] and then provided to marker inserter 32.

As shown in FIG. 6F, control word CW(i-1) is temporally stored in control word buffer 37 to be synchronized prior to being output and is utilized for descrambling the transmitted bit strips from marker inserter 32 in descrambler 24.

At this time, descrambler 24 uses marker detection flag signal m-det-flag from marker detector 31 as the reference signal for initializing based on control word CW(i-1) from control word buffer 37.

More specifically, descrambler 24 must be initialized by control word CW(i-N) from control word buffer 37 during a period from the point of generating encrypted marker EM(i), i.e., from a position of detecting marker detecting flag signal m-det-flag to the point before starting payload of a transport packet, where N is a natural number greater than zero. Here, control word CW(i-N) is a control word formed from encrypted marker EM(i-N) transmitted before encrypted marker EM(i) as many as N times. The natural number 'N' allows for arbitrarily controlling the initializing point of descrambler 24.

In the copy prevention method and apparatus of the digital [magnetic] recording/reproducing system according to the present invention as described above, a program supplier can select the copy prevention function, and the field defined within a GA format is utilized. As the result, a separate format transformation apparatus for the copy prevention function is not required, and there is no increase in data amount to be recorded to perform the copy prevention function without converting, for example, the general digital VCR.

While the present invention has been particularly shown and described with reference to particular embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be effected therein without departing from the spirit and scope of the invention as defined by the appended claims.